

The Alcazar of Seville in the 14th Century. An Integrated Project of Documentation, Research and Dissemination

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Abstract

The Alcazar of Seville is one of the monuments included in the World Heritage List for the city of Seville (Spain). It is an especially relevant complex both from an artistic and an historical point of view. Its buildings reflect over ten centuries of History of Spain and the city itself, as it has always functioned as a royal residence. This complex includes some of the most important Islamic and Mudejar buildings in Spain, and its long History has allowed the succession of numerous transformations, which can cause the original shape of buildings in each phase to be difficult to perceive. Based on a complete and detailed photogrammetric survey of the whole complex and on throughout historical and architectural research, the School of Arabic Studies (CSIC) has carried out a number of studies on the most outstanding phases of creation for the Alcazar, and especially in the 14th Century, when it reached its brightest moment. Not only as a way to further research, but also in order to disseminate scientific knowledge reached, a digital model has been made, showing how it should have looked like in the 14th Century. This model has been used to develop an audiovisual piece in which the most important parts of the complex are shown, and their main characteristics are explained.

Categories and Subject Descriptors: I.3.8 [Computer Graphics]: Applications

1. Introduction

The Alcazar of Seville is a monument with such historical and artistic value that it was included in the World Heritage List in 1987. The Alcazar dates back to the 10th Century, and is the oldest still in use royal palace in Europe. Its most interesting structures stretch from those corresponding to the Almohad period (12th Century) to the Baroque of the 18th Century, and including its Mudejar ones, built in the 14th Century with clear Islamic influences. This palace complex also suffered from important transformations during Renaissance and Baroque periods, which turned it into a wonderful example of cultural hybridization.

Defended by a number of military enclosures, the inside of the complex was occupied in the Islamic period by a number of palaces and residential houses which, from the moment the city was conquered by the Christians in 1248, were gradually adapted to the needs of the Castilian kings who established their residence there. In the 14th Century the complex reached a moment of splendour to which other residences of the time cannot be compared. After the works carried out by Peter I, by the middle of the

14th Century, the Alcazar became for that age the most sumptuous mansion that could be conceived by a Christian king, and was a worthy rival to the very famous Alhambra, which could not be surpassed for its privileged natural setting, although it could be compared as regards its beauty and splendour.

The basis of the new arrangement was the opening of a visual axis which began in the Gate of the Lion, which was opened up for this purpose, and reached as far as the impressive façade of the new royal residence, passing through another doorway which gave on to the central courtyard of the palace, known as the *Patio de la Montería*. This new complex complemented the older residences situated inside the Old Alcazar, in which the *Patio del Yeso* and another courtyard, known as the *Patio del Crucero* were set. The latter was an original Almohad building which had a garden at more than four metres below the level of the rooms. In the 13th Century the halls along the South side were reconstructed in Gothic style and arranged some raised paths over the garden in the shape of a cross to communicate with both ends of the courtyard. This palace



Figure 1: Actual section of the palace of Peter I.

was much altered in Baroque time, when its present appearance was achieved, and it had been in its time one of the most singular complexes in Spanish Islamic architecture.

Outside the Old Alcazar, with Peter I's new project, a large porticoed courtyard was planned outside the Old Alcazar. The original plan of this complex, known as the *Cuarto de la Montería*, included the construction of a *qubba* intended as the throne room that was started, but was left unfinished due to the king's death. On the South side, a new royal residence was built following the model of Islamic palaces. The building has an impressive façade, with a double turn entrance designed to preserve the owner's privacy, and is organized around a courtyard with a sunken garden surrounded by richly decorated porticoes. It had a reception hall on one of its sides.

Next to the *Cuarto de la Montería* there was another Almohad palace set around a courtyard with gardens, with sunken planted areas and with walkways in the shape of a cross. In the 14th Century, this building was subjected to considerable modifications, maybe as to adapt it to become a residence for important guests: the halls were enlarged, and the courtyard and the garden were re-laid. It was in this palace where the Catholic Kings, at the beginning of the 16th Century, established the *Casa de Contratación*, to regulate and control trade with the newly discovered America.

2. The survey

From 1997 to 1999 a complete survey of the Royal Alcazar was carried out, made possible by a number of agreements for scientific collaboration between the Patronage of the Alcazar and the School of Arabic Studies. The School of Arabic Studies had already been developing some documentation works, more specifically roof surveys including the whole area between the Cathedral and the Alcazar, using aerial photogrammetry. For three campaigns, elevations, sections and detail surveys of the different parts of the Alcazar were accomplished, most of them made using photogrammetric systems. They were considered the most suitable ones for this kind of task, as they can be carried out with barely any auxiliary means (scaffolding, cranes, and so on), take very short field-work time and provide great homogeneity in both accuracy and quantity of information to be included in the drawings. This is especially important in cases such as this, in which decoration shows very special characteristics and importance.

Complexes such as the *Patio de las Doncellas*, with its extensive lozenge decorated plaster surfaces, or the Ambassadors' Hall, with its semicircular woodwork cover can difficultly be measured and drawn without the use of photogrammetric techniques and computer aided design systems. These systems even allow the creation of three-dimensional models that can be visualized from different points of view and at different scales.



Figure 2: *Hypothetical cross section of the original palace of Peter I.*

The plans already made did not include every section and elevation of the Alcazar, but it was restricted to the most outstanding areas and elements, both architectural and artistically. It allows better knowledge and accurate information of the most important structures, and it can be used as a basis for a possible future development of complementary documentation works that should be linked to ordinary conservation and maintenance works on the monumental complex.

These works have been carried out using the semi-metric Rollei 6006 Metric camera and a Hasselblad SWC that had been converted into a semi-metric one in the School of Arabic Studies. To measure control points Wild T1000 and TCR303 theodolites have been used, the later one with a laser distance-metre. Plotting has been done with Leica SD2000 and Adam MPS2 stereo-plotter. For some detailed works a Kodak DC200 calibrated digital camera and VSD digital stereo plotter system from the AGH Cracow University have been used. All drawings have been digitally drawn using AutoCAD. The survey has been published in a special edition of a portfolio with 40 plates, 40x60 cm in size.

3. Historical and archaeological research

It has already been noted that the Alcazar suffered from a great number of transformations in the course of its history. Such changes have caused older phases to be masked or to disappear. The knowledge on the appearance of this monument in each of its phases is among the main aims of

our research, as it shows History, not only on a local scale or referred only to the monument, but also at a national level, as the detailed analysis of the building works of each time can be used in many cases to infer from them the underlying political objectives these constructive enterprises usually have. This research labour has a number of phases, among which photogrammetric survey is doubtlessly one of the most important ones.

After that, a extensive research on documents is needed. Fortunately, the Alcazar owns an historical archive that is well preserved, and also a number of monographs devoted to documentation related to different times, that allow us to follow quite in detail the works and interventions carried out along its History. Data provided by research in the archives is to be confronted to the physical reality of the building, with the objective of identifying each work and intervention included in the written sources. This task is mainly an archaeological one, and must be supported by other techniques such as the archaeology of architecture and the stratigraphic analysis of build-works or even dating using dendrochronology or any other suitable techniques. Furthermore, it must be completed with archaeological digs under ground level that ought to provide information on structures or disappeared elements, and on previous uses of the site.

These last few years, this kind of research has been carried out in the Alcazar, and the School of Arabic Studies has been participating through agreements with the Patronage of the Royal Alcazar and through a research Project of the Spanish National Research and Development Plan. The objective of our research is centred on Peter I

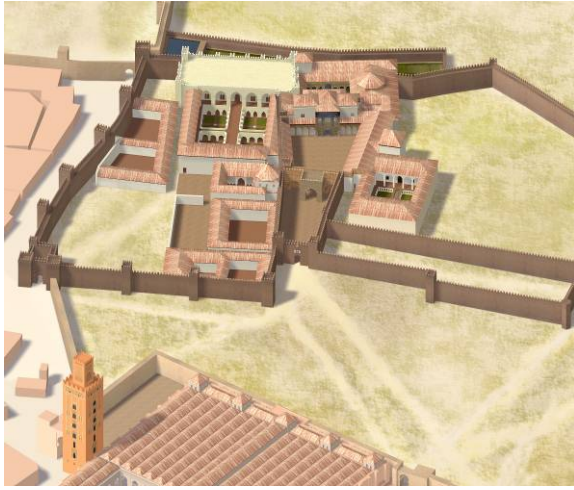


Figure 3: Aerial view of the Alcazar in the 14th Century

time, as the project's aim is the study of the palaces built by this king, of which the Alcazar is the most important one. Research works have been related to the recuperation of covered or disappeared structures which, because of their relevance have been considered worth of being made visible again. In other cases, tasks have consisted on simple conservation and maintenance works that, because of the dismantlement of fixed elements or the clearance of previously inaccessible areas have provided new data on the life and evolution of the monument. In some cases, archaeological surveys have been made in the walls, by partially removing plasters in order to see the inside structure of the walls.

The union of all these tasks have allowed us to know with some certainty the appearance the palace had in the time of its construction, and even parts of the project that were never finished. All of this information, logically has been represented through the necessary plans and drawings, and has been published in academic and dissemination spheres. However, many of these documents are difficult to comprehend by people who are not used to working with plans, and we thought that the results of our research were of interest to the public that visit the monument and to scientists and experts that develop their research in this field. Thus, we have been developing a number of dissemination activities using digital models that doubtlessly allow the public to have a better understanding on the past.

4. Modelling Methodology

4.1. Modelling in AutoCad

The starting point for the modelling is always graphic information from .dwg archives (plans, sections and

elevations) generated using photogrammetric surveys. After removing unnecessary information in these drawings, the next step is to standardize the design of plans and elevations, trying, whenever it is possible, to use symmetries and the repetition of geometrically similar elements. All these drawings are then referenced to a new coordinate system origin, which is set at the intersection of the general symmetry axes of the complex, and to an UCS that is orthogonal to this axes.

The so obtained .dwg archive is the interchange base with 3DStudio, that is to say, every element sited in the space of this drawing will be present in this three-dimensional model. The generation of 3D entities in AutoCAD is made thought the *extrusion* command of a solid object created from a flat polyline drawn over each element, to which a certain height or an extrusion axe is assigned. Other operations with solid objects are also used, according to the spatial complexity of the object to be modelled and the suitability of the different AutoCAD commands: *revolution solids*, *solids' union*, *solids' subtraction*, *solids' intersection*...

4.2. Creation of textures using ASRix and Adobe Photoshop

One of the initial plans in our work was the achievement of a model as realist as possible, and, in order to do so, real and high quality textures and materials were used on the model, taking advantage from the possibilities offered by digital photography.

Using images taken in situ and photographic manipulation software such as Photoshop, we generated tileable textures (textures in which no transition is perceived when repeated continuously) that where applied to elements with big surfaces and a continuous finish, such as covers, walls or the mortar of walls.



Figure 4: The Patio de la Montería



Figure 5: *Facade of the Palace of Peter I in the 14th Century*

In certain elements, of relatively small size and that cannot support continuous textures, such as socles, decoration stripes, plasterworks and pavements, in the process a rectification in the original image is added, in order to prevent possible distortions when applying the texture. To do so, we use ASRix rectification software, which is easy to use and barely requires any training. It is enough to have a digital image of the flat element that is to be rectified and to know the coordinates of at least four of its points that can be obtained directly from the AutoCAD drawing itself.

4.3. Creation of images using 3DStudio

Three-dimensional elements that have been previously created in AutoCAD are now imported into 3DStudio. Each AutoCAD layer imported into 3DStudio will be interpreted in 3DStudio as a stand-alone object, and, thus, it is necessary to decide, already in the modelling phase, which objects are to be used in the model, as well as their properties and final appearance. Later, a library will be created with the materials from the model, using the maps

and textures previously created, and they will be applied to each three-dimensional object, once their geometrical characteristics have been defined.

The introduction of light effects may be the most important part of the process carried out in 3DStudio. In a computer graphic reconstruction light should imitate the real solar circumstances for which the structure was built. 3DStudio can create solar light, and orientate and measure it according to the geographical position of the building and the chosen time of the day. There are also lighting systems (ray tracing and radiosity) that generate a lighting model that takes into account the reflection and refraction of light on the surface of each object in the scene, as well as their interaction, just as it happens in reality. However, the use of this type of ideal light has huge hardware requirements and, thus, an option is taken in favour of other types of lighting that have fewer requirements, and that provide an acceptable lighting final quality in its perception.

There are no limits in the possible position and orientation of the cameras, although it is advisable to choose a point of view similar to that of a real spectator,



Figure 6: *The Almohade portico of the Patio del Crucero.*

and a camera lens that distorts the visualization of the complex as little as possible, so that it imitates the human perception of reality as much as possible.

In order to achieve more realism in the final images and animations, a number of effects can be used: fog, light volumes, water reflections, and the use of real images in the surrounds... On the other hand, the use of RPC's (a system used to work with three-dimensional images) permits the introduction in the scene of vegetation, objects and people, either static or animated ones, without having to model them, but simply cutting and pasting them in the scene.

5. The use of the model: images and animations

The creation of computer-generated images from the rendering of the scenes is, in some cases, the final aim of the process. These images permit a perception of the space similar to that given by a photographic image, although in this case what is represented is not real, but virtual.

Apart from these images, factors like time and movement can also be incorporated to the virtual model, through the generation of animations that help understanding the space of the architectonic environment in a more complete way. The experience of movement and the changing image of the object that it produces, can, without any doubt, provide the best three-dimensional perception possible. In order to do so, it is fundamental to choose an adequate route according to the type of architecture and the sensations that want to be transmitted. The speed given to the movement (which depends on the number of frames that create the timeline in 3DStudio) and the control of the camera lens to visualize the animation (to where and how it is looking) are also of main importance. As a reference, it can be said that, for the average speed for a walk at 2.5 km/h the time variable to be introduced is of 35 frames per metre in the route. The lenses of the camera used in our animations were of 28 mm and 35 mm.

While the spectator moves through the scene following the designated route, any entity in the model can be animated: a geometrical element, an effect, a certain light... and, thus, the perceptive possibilities given by animation can be greatly increased.

The final stage of this process is the rendering of sequences, which can be generated following two different systems:

- In video format, directly, so that the animation can be immediately visualized in any video player that supports this type of files.
- One frame at a time, which implies the later use of some kind of software for video editing.

The first option is recommended for simple models, with continuous routes and short animations. It is faster than the second process, but it has the disadvantage of having to redo the whole animation if any kind of modification in the scene wants to be introduced, or if there is a failure in the IT system. Therefore, it can imply the loss of much time if problems arise or there are many changes in the routes or in the model itself.

5.1. Video editing with Adobe Premier

Once the animating and rendering phase is finished, it will be necessary to edit the graphic material to obtain the desired results. This is the so-called postproduction phase. In it, apart from giving shape to the production through the structuring of the different sequences according to a predefined outline, the introduction of titles, sound, special effects, fades and pauses, video and audio transitions, and so on, are also done. This group of elements permits the creation of a narrative outline for the animation using mostly a sensorial language.

The use of this software is really simple and very intuitive. Basically, it consists on the manufacture of a collage with the image files created in 3DStudio and the



Figure 7: *The Gothic portico of the Patio del Crucero*



Figure 8: *The Patio de las Doncellas in the 14th Century.*

audio files (music and voice) that are exported into video format with the chosen definition.

6. The audiovisual project “The Alcazar of Seville in the 14th Century”

Our interest in disseminating and showing the results of our research to non-specialist public has lead us to increase the use of computer-generated images. These resources allow us not only to fulfil this social demand, but also to enrich our own experience and that of our colleagues and specialists. Thus, this project is in the main line of our research, in which we gather together previous works, historical and archaeological updated researches and social needs linked to cultural events.

One of the main characteristics of this project is that all of it has been developed by the same working group, functioning at the same place and with similar criteria and training. The experience that has been gained in the School

of Arabic Studies for the last few years in this type of activity has provided us with the technical ability and knowledge to develop every phase of the process, from planimetric survey to the final cut of the audiovisual product. We can say that only the voice in the audiovisual has been done on a different place and by people who are outside the group.

Our extensive experience in documentation and planimetric survey has allowed us to work taking whole benefit of the possibilities offered by three-dimensional restitution and the creation of 3D models directly from the photogrammetric plotting. We have been the principal authors of the historical research, either by developing it directly or by using data provided by some colleagues who work in the Alcazar, and reviewing it, synthesizing it, and transforming it into sufficiently based proposals of hypotheses.

The models are generated by personnel who have a long experience in the field of Islamic architecture, and

who know its shapes and the characteristics of its decoration. We have an extensive database of plans and details from the different architectonic types corresponding to each phase, decorations, textures, and so on. On the other hand, these tasks have been carried out in its entirety by architects or architecture students in their last course of University, with good spatial vision and a solid knowledge on architectural principles. This has allowed us to always work on solid and well-built hypotheses.

The advantages of this way of working are clear. As we are one single working group there are no language or understanding problems concerning objects and their representation or on the definition of objectives. Each member of the workgroup shares the same interest on the problems raised throughout the whole process, and the solutions that are taken.

On the other hand, low-sophisticated and standard solutions have always been chosen, always aiming more for the diffusion of the system itself than for it to be spectacular. Results are more indebted to previous documentation and research labour than to IT work, in which advances made both in hardware and in software allow us to achieve more spectacular effects and results every day, and with less effort.

Using this baggage, we have approached this important project, which was requested by the Patronage of the Royal Alcazar and the Foundation of The Legacy of al-Andalus. The original motive was the celebration of an exhibition on "Ibn Khaldun, Rise and Fall of the Imperious". This important person, who has been considered to be the father of historiography, first knew the Alcazar of Seville when he went to visit the court of Peter I

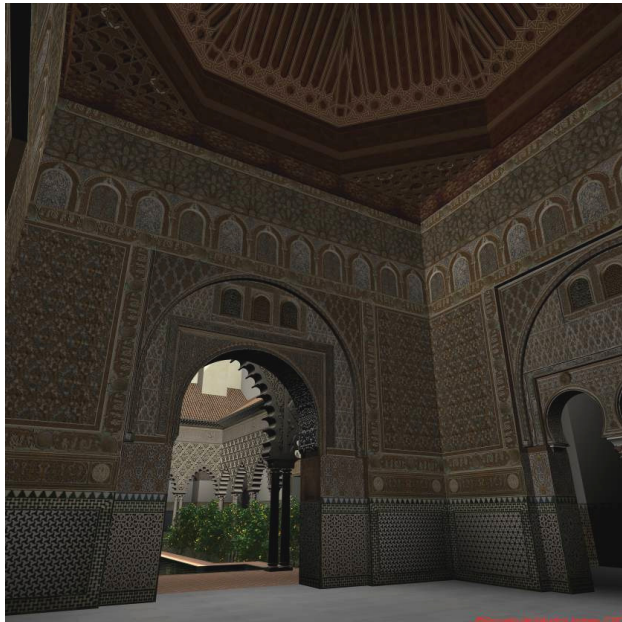


Figure 9: The reception hall of the Palace of Peter I.

as an ambassador of the Sultan of Granada. Our intention was to show the visitor of the exhibition the appearance of the palace at that time or, to be more precise, what the project that was being carried out was, as in the year when he was in Seville the palace was still under construction.

The complete model of the core of the Alcazar permits a detailed visit to its different parts, led by a text read by an off-screen voice explaining what is being shown, that is to say, the palace such as it was in the mid 14th Century and, in some cases, the modifications made to previous phases. This virtual visit helps to understand part of the complex reality this important monument contains.

This kind of work is to be developed in the future for other cases and monuments.

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